Nuclear Fuel Cask Storage

Nuclear Cooperation Meeting on
Spent Fuel and High-Level Waste
Storage and Disposal
Las Vegas, NV

March 7, 2000

Presented by
NAC International
William McConaghy
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Presentation Topics

I. Dry Storage Cask Installations

II. UMS® Design Features

III. Cask Loading Operations

IV. UMS® Licensing Status

V. Centralized (AFR) Storage

VI. Summary

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Dry Storage Technologies in Use

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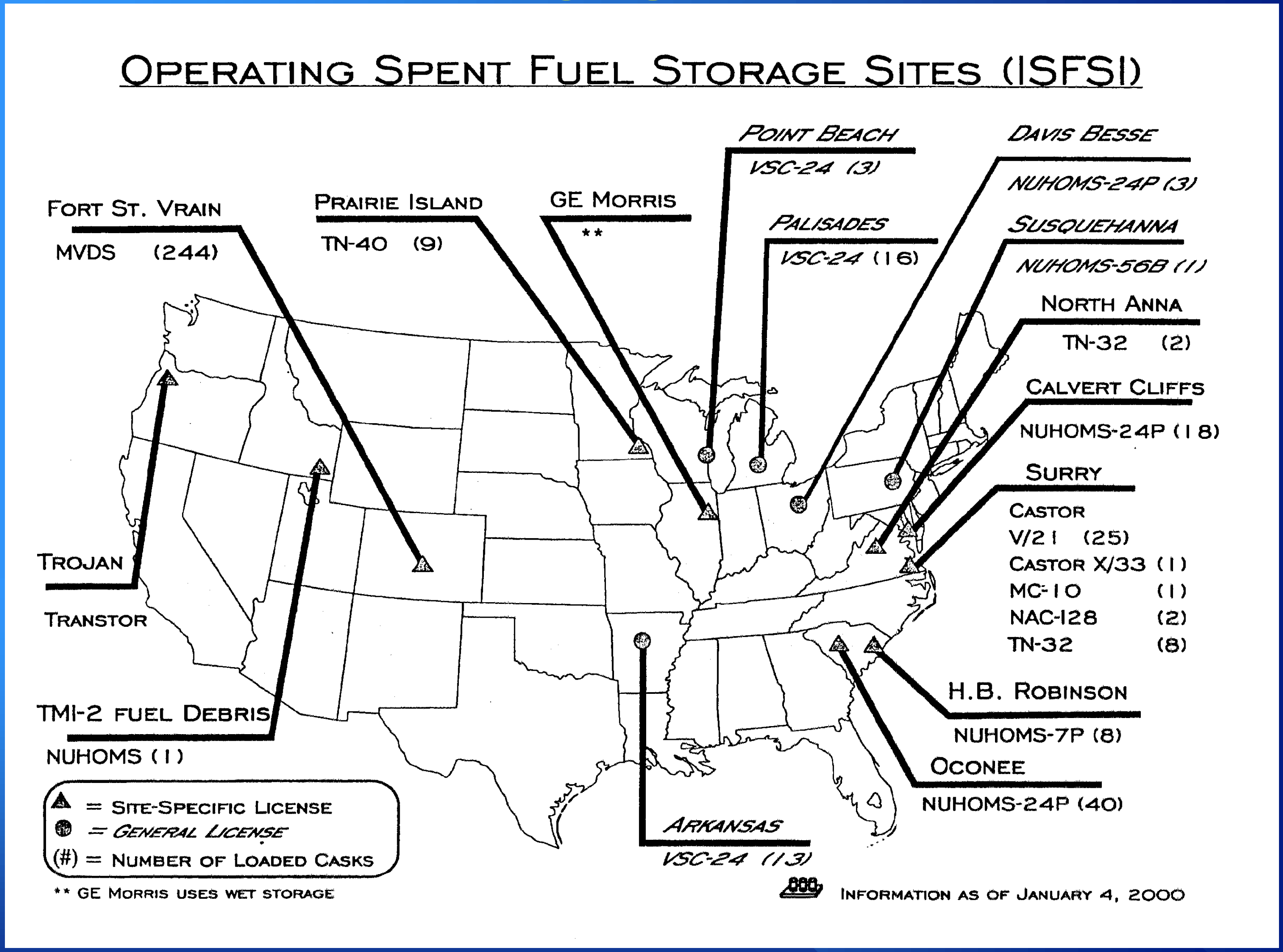
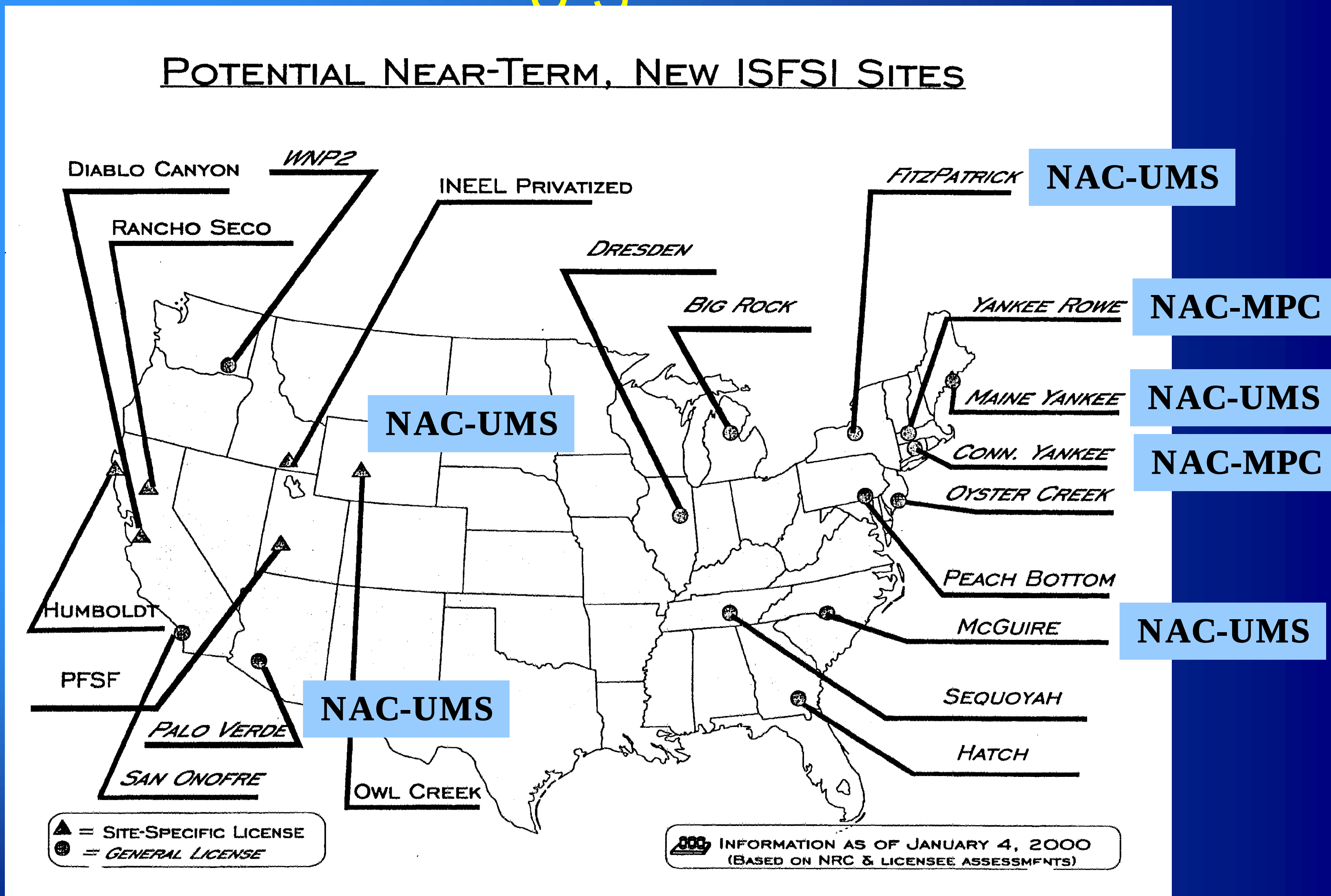
Dry Storage Facilities in the U.S.



Dry Storage Facilities Planned in the U.S



Cask Technology Evolution

The **NAC-LWT** (legal-weight truck) cask, licensed in 1989, has served as the workhorse for DOE shipments of highly enriched spent fuel from foreign research reactors around the world.

NAC licensed the **NAC S/T** 125-ton storage cask system in 1990. The inset picture shows the NAC S/T in use at Virginia Power's Surry ISFSI.

In 1995, the 125-ton **NAC-STC** became the first spent fuel management technology licensed for both storage and transport. The picture above shows a licensed version of the NAC-STC for European use. NAC based its future multipurpose technologies on this approved cask and basket design.

In March 1999, the **NAC-MPC** multipurpose canister system received a transportation certificate of compliance (COC) and a preliminary safety evaluation report for storage by the NRC. NAC anticipates final storage approval in 1999. The inset shows the Yankee Rowe nuclear station, which will use the NAC-MPC technology. The Connecticut Yankee plant also will use the NAC-MPC.

The **UMS** is designed to accommodate almost all U.S. and international spent fuel. NAC will provide the UMS technology to Arizona Public Service, Duke Energy and Maine Yankee. The UMS received a preliminary storage COC in November 1999 and projects a transport COC in 2000.

The **Advanced UMS** provides enhanced PWR (32-assembly) and BWR (69-assembly) basket capacities while using the standard UMS overpacks and ancillary equipment. NAC will license the Advanced UMS by amendment, with submittals in 2000 and final approval projected for 2001.

NAC Spent Fuel Technology

NAC Licenses & Certificates of Compliance

Cask Designation	Certificate of Compliance Number	Number of CoC Rev./ Application	Status/ Number of Systems	Issuing Agency	IAEA Approval
NLI-1/2	71-9010	39/Transport	Active/5	NRC	Yes
NAC-1	71-9183	13/Transport	Active/6	NRC	Yes
NLI-10/24	71-9023	8/Transport	Active/2	NRC	Yes
NAC-LWT	71-9225	19/Transport	Active/5	NRC	Yes
NAC-I26 S/T	72-1002	1/Storage	Active/1	NRC	N/A
NAC-C28 S/T	72-1003	1/Storage	Active/0	NRC	N/A
NAC-I28 S/T	72-1020	Letter/Storage	Active/2	NRC	N/A
NAC-STC	71-9235	2/Transport	Active/0	NRC	Yes
	72-1013	Letter/Storage	Active/0	NRC	N/A
NAC-MPC	71-9235	Transport	Active/0	NRC	Yes
	72-1025	Storage	March 1999 (in rulemakin	NRC	N/A
UMS®	Docket No. 71-927(Docket No. 72-1015	Transport Storage	April 1997 (under NRC review) November 1999 (in rulemak	NRC NRC	Yes N/A
Enhanced UMS®	Pending	Transport Storage	Pending	Pending	Pending

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The Universal MPC System®

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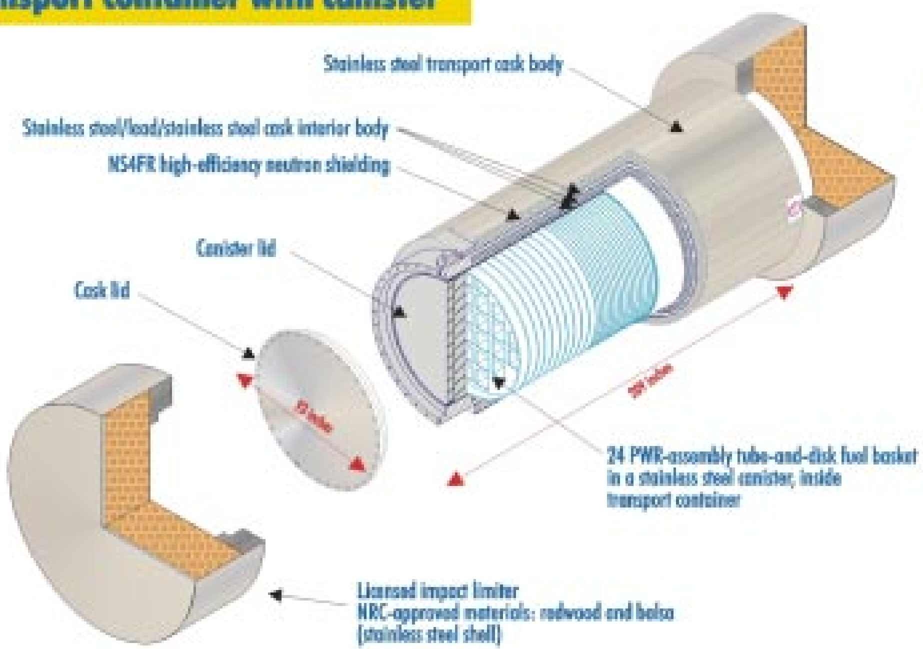
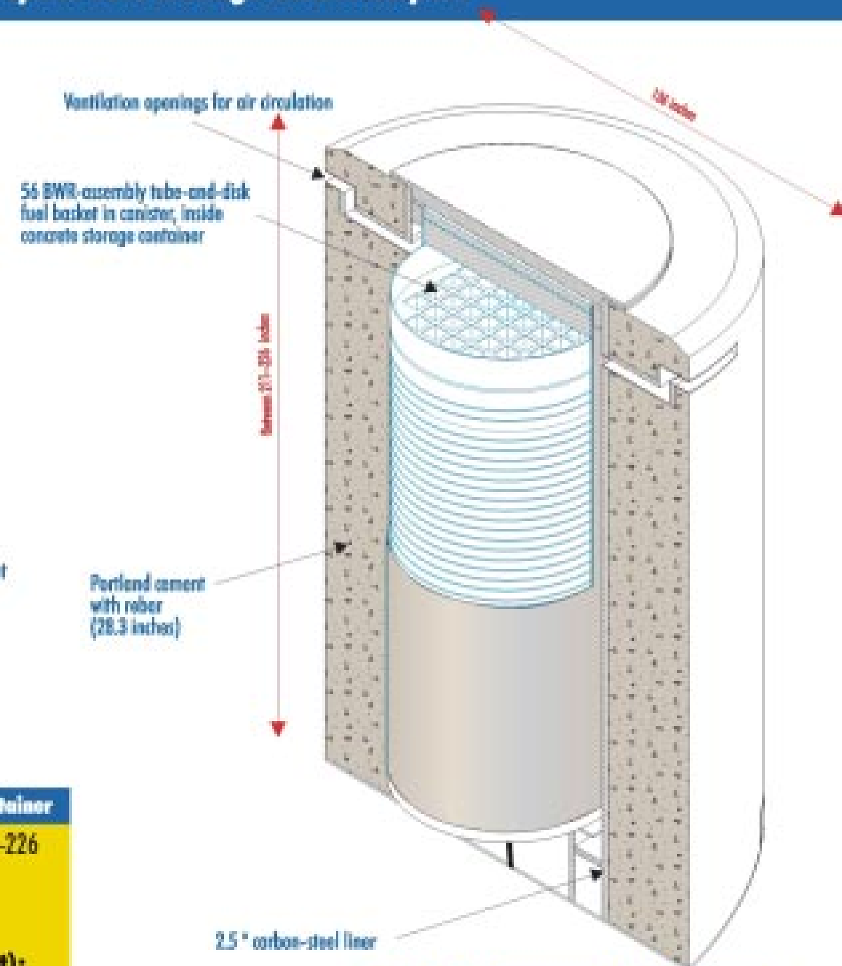
UMS®

NAC's Multi-Purpose Canister system for spent fuel storage and transport

Transport container with canister





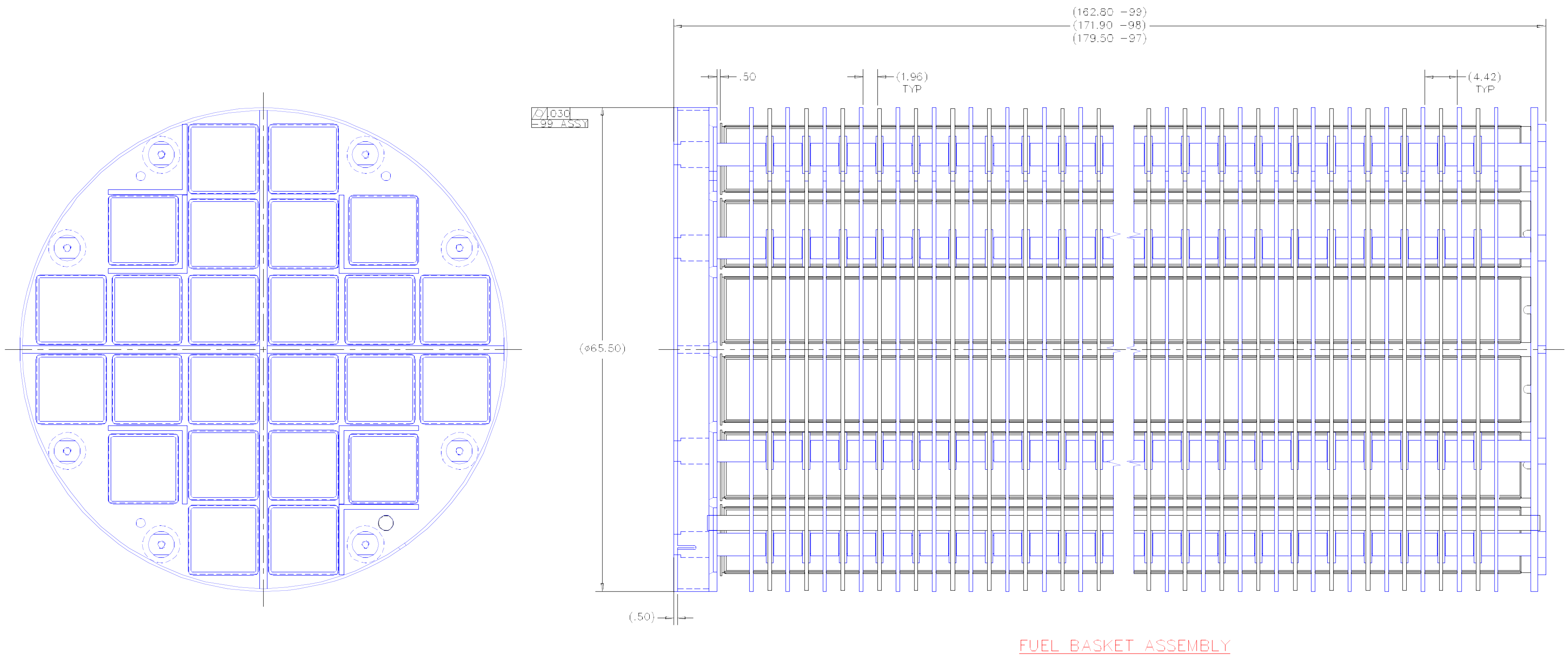
Vertical concrete storage container with canister

Transportable storage canister	Transport container	Vertical concrete storage container
Length: five sizes from 175–192 inches	**Length:** 209 inches	**Length:** five sizes from 211–226 inches
Diameter: 67 inches	**Diameter without impact limiters:** 93 inches	**Diameter:** 136 inches
Weight empty (heaviest): 19 tons	**Weight empty:** 83 tons (w/o impact limiters)	**Weight empty (heaviest):** 121 tons
Weight loaded (heaviest): 38 tons	**Weight loaded (heaviest):** 126 tons	**Weight loaded (heaviest):** 160 tons

UMS® Design Features

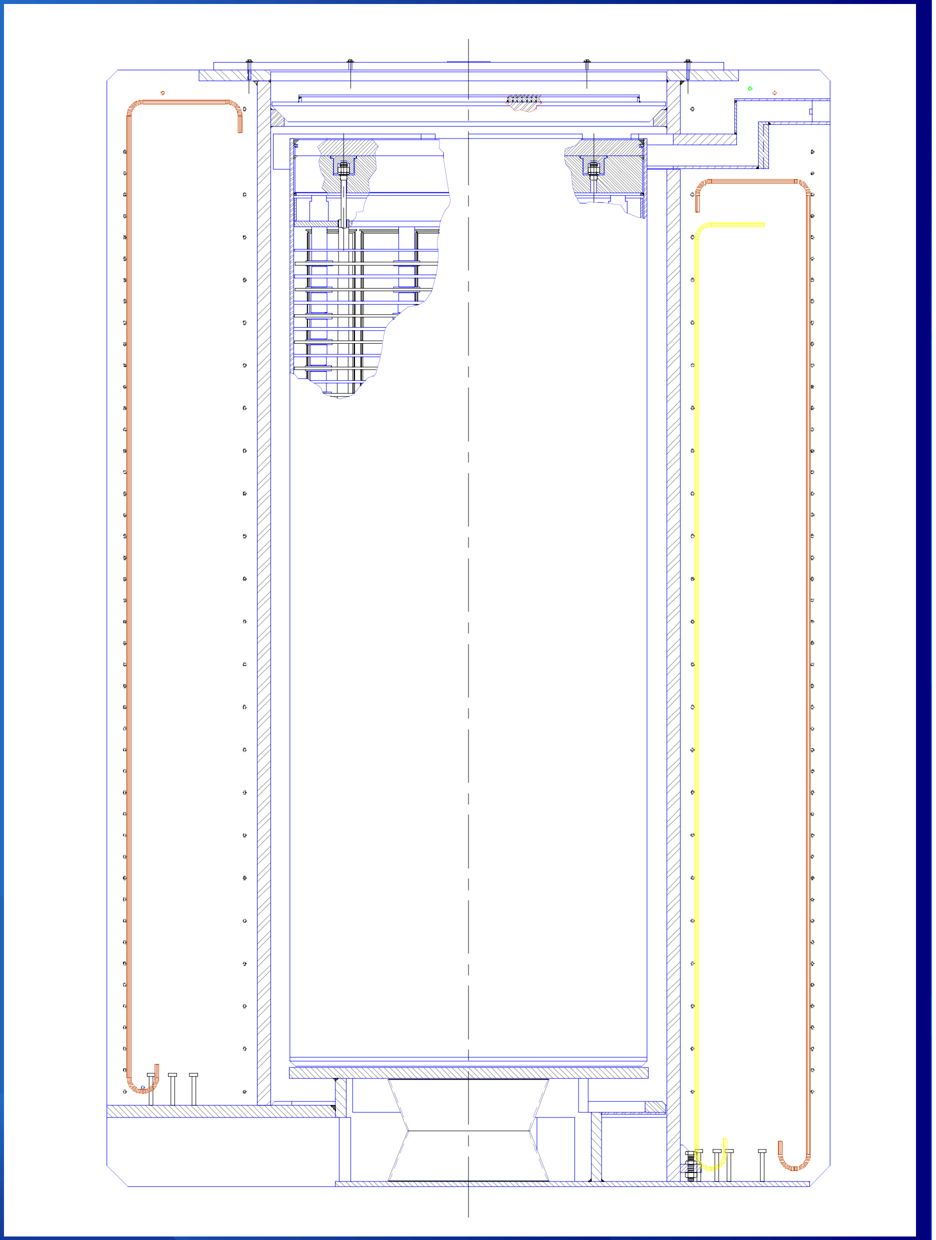
UMS™	PWR	BWR
Capacity	24 Fuel Assemblies	56 Fuel Assemblies
Thermal Capacity—Storage	25.2 kW	24 kW
Transport	20 kW	16 kW
Fuel Cool Time—Storage	5 years	5 years
Transport	10 years	10 years
Fuel Maximum Enrichment	4.2 batch average w/o U^{235}	3.75 w/o U^{235}
Fuel Burnup—Storage	40,000 MWD/MTU (see attached for high BU)	40,000 MWD/MTU (see attached for high BU)
Fuel Burnup—Transport	45,000 MWD/MTU	40,000 MWD/MTU
Internal Fuel Cavity Length	163.3 inches	173.8 - 178.6 inches
Internal Basket Cavity Diameter	65.8 inches	65.8 inches
Fuel Cell Opening	8.8 inches square	5.9 inches square (w/ 4 @ 6.05)
Overall Length	175.3 inches	185.8 - 190.6 inches
Shell Outer Diameter	67.1 inches	67.1 inches
Shell Thickness	0.60 inches	0.60 inches
Shell Material	304L Stainless Steel	304L Stainless Steel
Neutron Poison	Boral	Boral
Structural Lid	3 inches, 304L Stainless Steel	3 inches, 304L Stainless Steel
Shield Lid	7 inches, 304 Stainless Steel	7 inches, 304 Stainless Steel
Support Disks	1/2-inch 17-4 PH SS	5/8-inch carbon steel (coated)
Heat Transfer Disks	1/2-inch Aluminum 6061-T6	1/2-inch Aluminum 6061-T6

Storage Canister (PWR Shown)



Concrete Storage Overpack

- Reinforced concrete structure with a 2.5" thick steel liner
- 136" outer diameter
  - Reusable, transportable to other sites
- Footprint load ~146-152 tons
- Required spacing ~15 feet on centers



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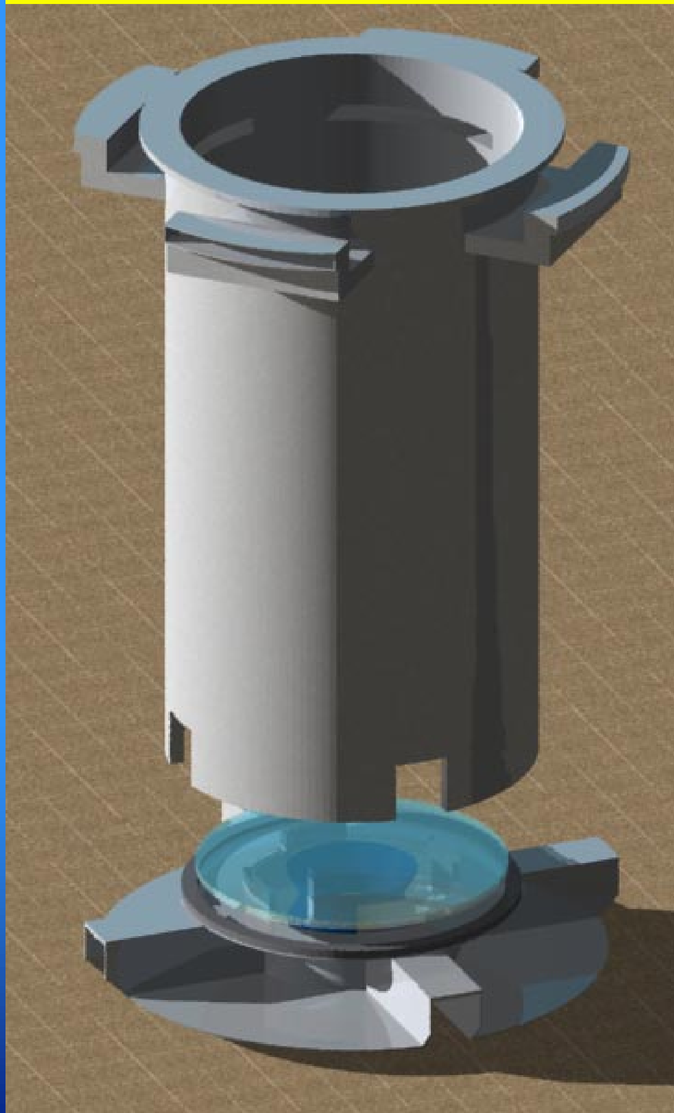
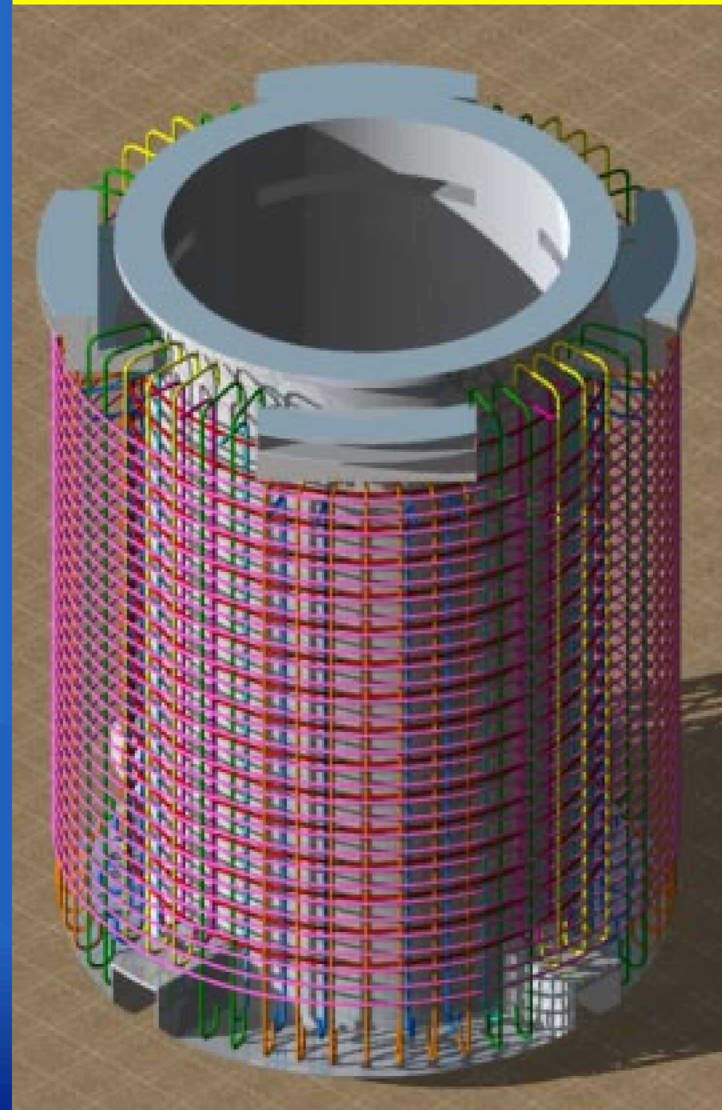
Vertical Concrete Cask Liner



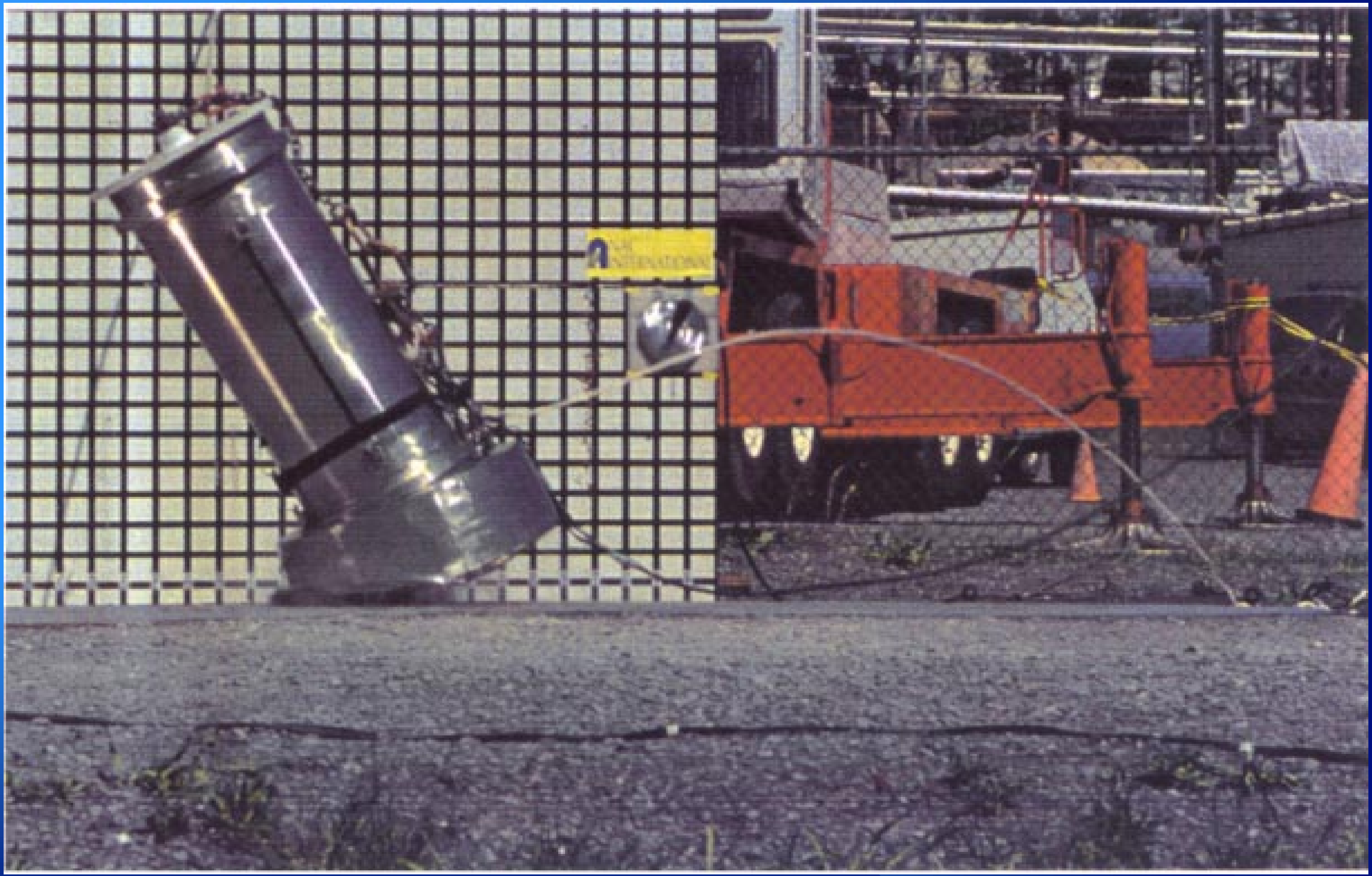
Vertical Concrete Cask Rebar



UMS® Transportation System Design Methodology

- Proven and licensed ASME Section III containment boundary material with no brittle fracture issues
- Proven and licensed transport cask body design (SS/Pb/SS)
- Proven and licensed cask closure designs
- Proven and licensed neutron shield system
- Proven, licensed and tested impact limiter design
- Proven, licensed and tested impact limiter attachment system

Drop Testing the NAC-UMS®



Center of gravity over corner drop.

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Features of Enhanced UMS®

- Enhanced capacity—up to 32 assemblies per basket, depending upon actinide burnup credit
- Enhanced UMS® uses same concrete cask, ancillary equipment and transport overpack as UMS®
- Substantial savings with enhanced UMS®:
- Easily fabricated—no final assembly welding

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Technical Characteristics of Enhanced UMS®

- Combines tube-and-disk technology with connected cell technology
- Multiple modules assembled vertically in canister through mechanical methods, constructing a full-length basket structure
- Very limited welding
- Maximizes capacity, while minimizing analysis and fabrication problems associated with full-length connected cell technology

Technical Characteristics of Enhanced UMS® (Continued)

- Very thermally efficient: uses carbon steel basket with connected cell approach to increase conductivity and reduce thermal gaps
- Mechanical restraints absorb accident condition structural loads, similar to disks
- Maintains fuel element geometry for criticality issues
- NRC burnup credit may allow closer packing of moderately enriched, highly burned fuel
- Drop testing of UMS® bounds enhanced

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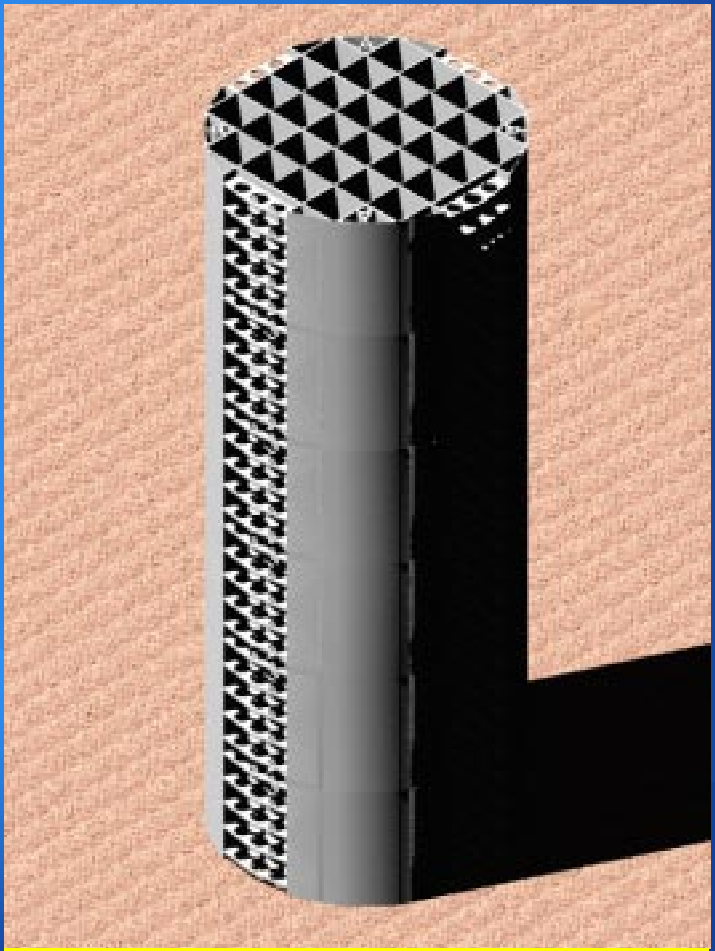
Enhanced UMS®
PWR Assembly



32-Assembly PWR
Fuel Basket

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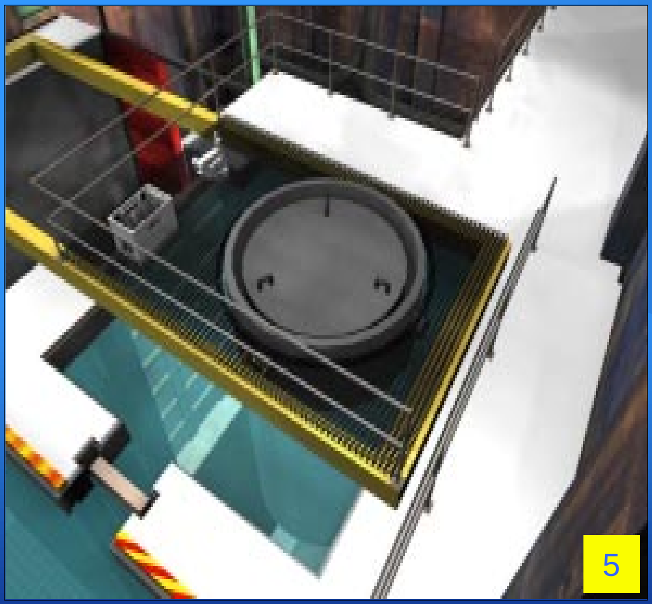
Dry Cask Loading Process

- Place empty canister inside transfer cask
- Locate transfer cask on stand in load pit
- Load fuel assemblies into canister
- Place support frame and work platform over cask load pit
- Lower shield lid onto top of loaded canister
- Lower water level in cask load pit in preparation for lifting transfer cask

Dry Cask Loading Process



- Lift transfer cask up to 140' elevation and place in support frame
- Remove 50 gals water from canister
- Weld shield lid in place
- Pump remaining water from canister
- Weld cover on drain port
- Vacuum dry the canister
- Backfill canister with helium
- Weld cover on vent port

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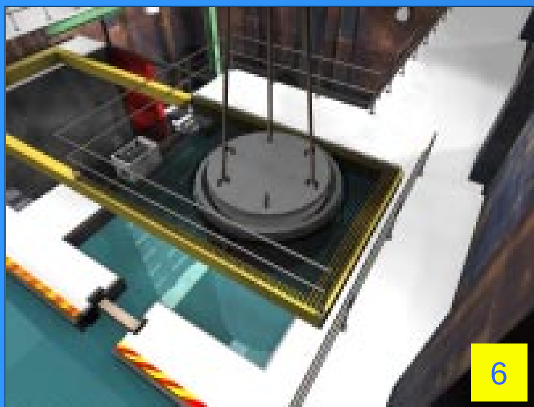
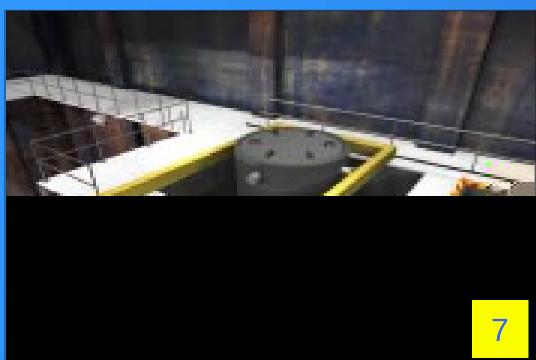
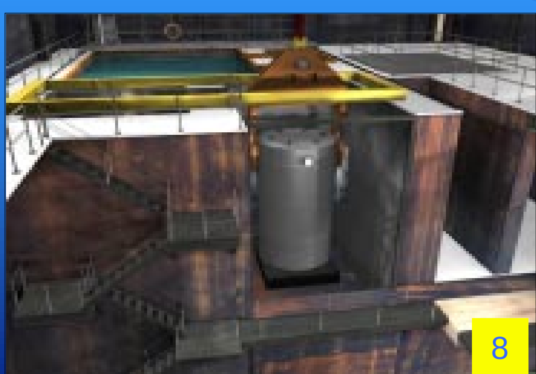
Dry Cask Loading Process







- Lower structural lid onto canister
- Weld structural lid in place
- Drain water in cask load pit below 124’ elevation
- Remove work platform
- Remove large gate to decon pit
- Move transfer cask through gate and place on stand in decon pit
- Remove support frame
- Decon canister and transfer cask

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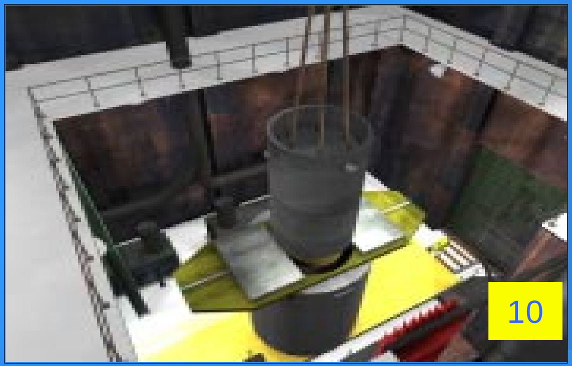
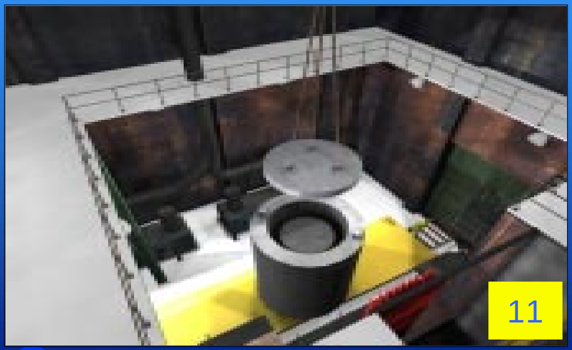
Dry Cask Loading Process





- Stage VCC on rail car inside fuel building
- Position adapter plate on top of Vertical Concrete Cask (VCC)
- Position transfer cask on top of adapter plate
- Disconnect lifting yoke from transfer cask
- Attach 6-point sling to canister structural lid
- Lift canister slightly and open doors on bottom of transfer cask
- Lower canister into VCC
- Remove transfer cask and adapter plate
- Install VCC shield plug
- Lower VCC shield lid and fasten with bolts

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Dry Cask Loading Process

- Tow rail car with loaded VCC to ISFSI

- Remove VCC from rail car and transport to storage pad

- Position VCC on storage pad
- Install screens on air inlets
- Install temperature monitoring equipment

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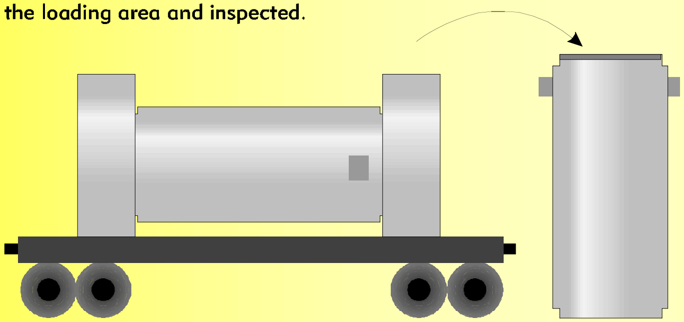
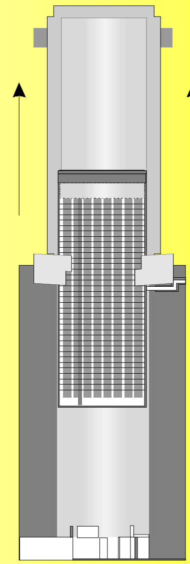
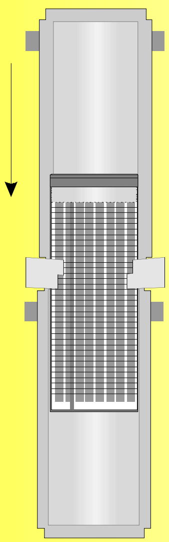
Transport Preparation & Loading

UTC transportable storage cask is removed from railcar, lifted upright in the loading area and inspected.



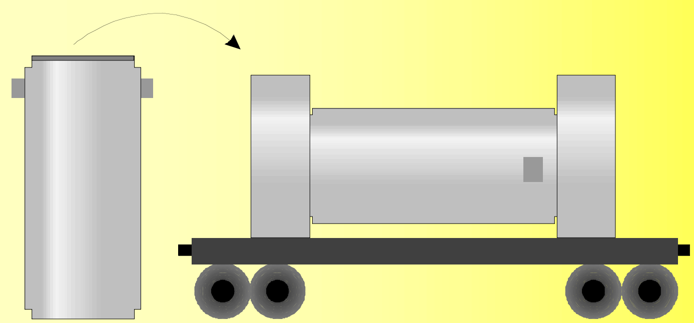
The concrete storage overpack lid is removed, and the transfer cask is then lifted onto the concrete overpack. The canister is lifted into the transfer cask, which is removed from the concrete overpack.





The transfer cask is lifted and positioned on the UTC. The canister is lowered into the cask. The transfer cask is removed, and the UTC lid is replaced and bolted.

Following leak tests, the UTC is placed on the railcar with impact limiters for transport.



Vertical Concrete Cask Work in Progress

Licensing Status

	1996	1997	1998	1999	2000
NAC-STC/MPC					
NAC-STC Transport	12/96 Submitted to NRC	12/97 RAI-1 issued		3/99 CoC issued	
NAC-MPC Storage		4/97 Submitted to NRC	1/98 RAI-1 issued	3/99 - Draft SER & CoC issued	3/00 CoC issued
NAC-UMS					
NAC-UMS Transport		4/97 Submitted to NRC 8/97 Accepted for Review	8/98 RAI-1 issued	2/99 RAI-1 resp. sent 6/99 Drop Test & MY fuel	4/00 RAI-2 or Coc/SER to be issued 6/00 RAI-2 resp. to be sent, if necessary 8/00 Coc & SER to be issued
NAC-UMS Storage		9/97 Submitted to NRC 12/97 Accepted for Review	8/98 Tech. Review 10/98 RAI-1 issued	1/99 RAI-1 resp. sent 6/99 RAI-2 issued 8/99 RAI-2 resp. sent 11/99 Draft SER & CoC issued	10/00 CoC to be issued

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UMS® and Enhanced UMS® Licensing Status

- Received UMS® preliminary SER for 10 CFR Part 72 in November 1999
- Final COC for UMS® storage and transport applications expected to be received October 2000
- Enhanced capacity UMS® design planned for submittal to the NRC by late 2000
- Enhanced UMS® available for loading in 2003

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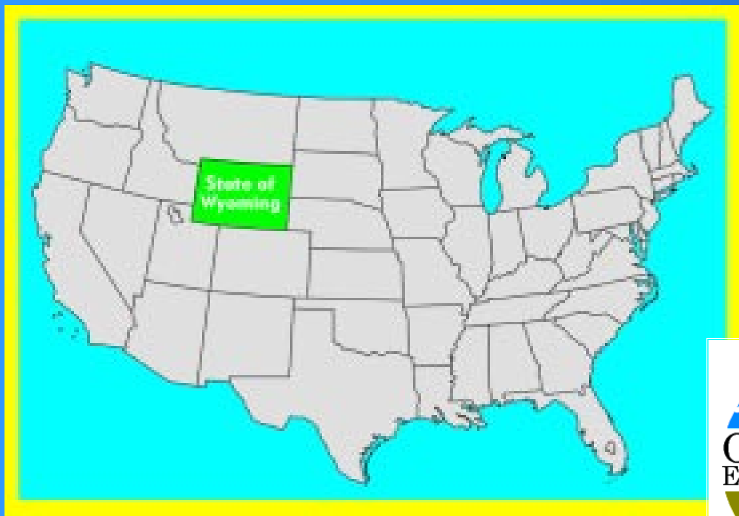
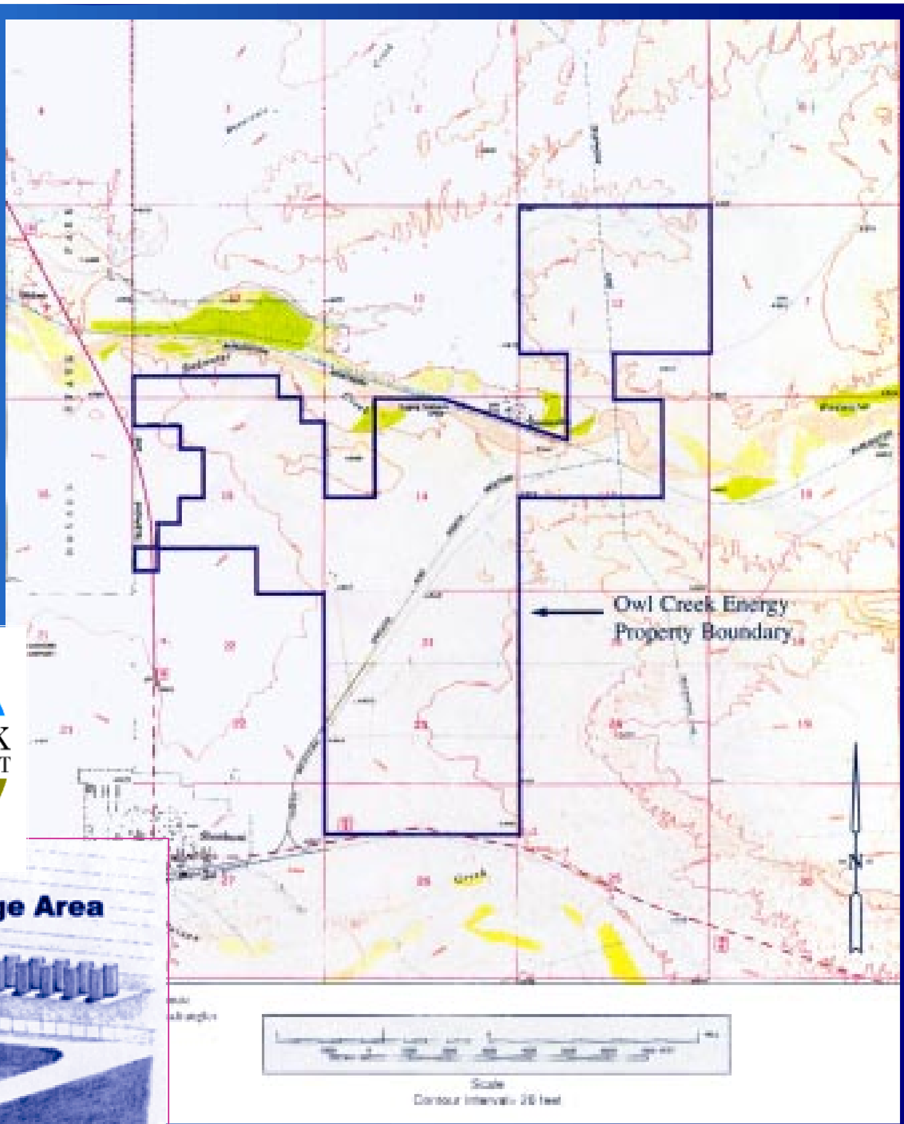
Owl Creek Energy Project





OWL CREEK ENERGY PROJECT

Summary

- Dry cask technology is a mature, proven method for accommodating increasing spent fuel storage needs.
- NRC licensing schedules have become more predictable recently, allowing utilities to better plan projects.
- Licensing issues still remain for important topics needed for storage and transport of the next generation of fuel.
  - High Burnup
  - Burnup Credit
- Private AFR storage remains a viable option to accelerate the process of removal of fuel from the plant sites.

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